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The Influence of Calibrator Parameters in Electrical Power Protection Devices Testing Systems

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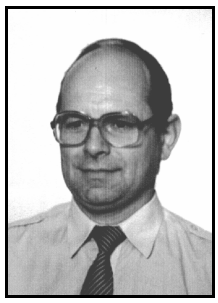

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Absolwent Wydziału Elektrycznego Uniwersytetu Zielonogórskiego. Obecnie słuchacz studium doktoranckiego. Zajmuje się zagadnieniami związanymi z automatyką zabezpieczeniową, a w szczególności z testowaniem mikroprocesorowych sterowników polowych.

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Abstract

This paper presents the impact of multiphase signals generator parameters on electrical power protection devices testing process. Publication include a short presentation of electrical protection devices and testing methods. Obtained results of simulation tests (parameters matrix) are presented. Optimization of multiphase signals generator parameters influences testing time and quality.

Keywords: Electrical Power Safety Devices, calibrator, overcurrent protection, shortcircuit protection, digital field controller.

Wpływ parametrów kalibratora na proces testowania urządzeń EAZ

Streszczenie

Artykuł ukazuje zagadnienie wpływu właściwości dynamicznych zadajnika sygnałów wielofazowych na proces testowania urządzeń EAZ (elektroenergetyczna automatyka zabezpieczeniowa). Publikacja zawiera krótką charakterystykę obiektu (urządzenie EAZ), oraz obecnie stosowane metody testowania. Zaprezentowano wyniki badań symulacyjnych, w tym optymalny zestaw nastaw dla obiektu o zadanych parametrach dynamicznych. Właściwy dobór nastaw pozwolił na skrócenie czasu testowania, bez pogorszenia jakości.

Słowa kluczowe: urządzenia EAZ, kalibrator, zabezpieczenie nadprądowe, zabezpieczenie zwarciowe, mikroprocesorowy sterownik polowy.

1. Introduce

Dynamic development in Electrical Power Protection Devices require application of modern and effective testing metods. Multifunctional, digital safety devices, equipped with automatic function, like SRC (self re-connect), SFD (self frequency disconnect), SSBC (self stand-by connect) require universal testers and optymalization of testing process. It is mean short testing process and acceptable quality. Digital devices require applicatin of integrated testing systems (for example KOKOS, OMICRON, ISA) or closed testing systems including calibrator as multiphase signals generator, computer with maesurment card and software. The aim of this publication is show the influence of calibrator parameters as most important part of testing system on Electrical Power Automatic Protection Devices testing process.

2. Object

The object is digital field controller. Those devices are made in Poland, for example in ZEG-Energetyka Tychy (CZAZ), Energotest-Energopomiar Gliwice (APZ), JM Tronic (MultiMuz). Those devices have many safety functions: over current protection, short-circuit protection, frequency protection and many others. They have reconnect function (APZ) and can work in SRC, SFD and SSBC systems (CZAZ).

Those devices work with circuit-breakers, for example SF_6 breakers VD-4 produced by ABB. Field controller is connect with power-network by current and voltage transformers (for CZAZ, input current 5A and 1A, input voltage 100V). Controller check power-network continuously. In case of dangeruos increase of parameters, emergency signal is generated. When limit level is exceed, disable signal is generated.

Emergency signals are generated too in case of error in selfcontrol, for example no supply. Functions and parameters settings for controller can be chosen in DCS (digital control system) or local, by RS 232 or RS 485.

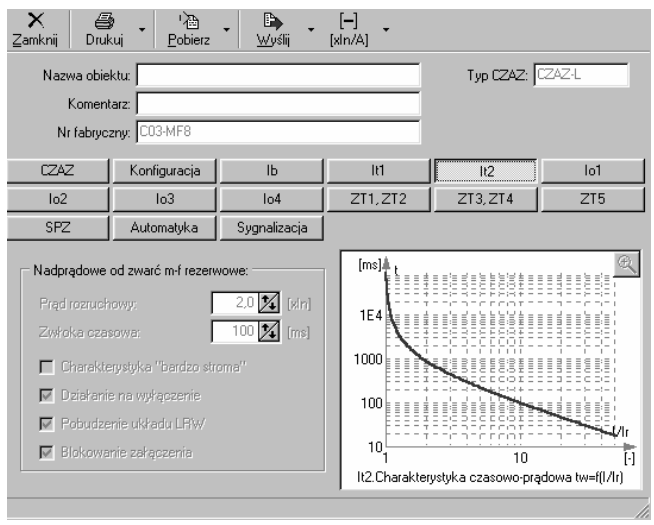


Fig. 1. CZAZ – settings [6]
Rys. 1. CZAZ – konfiguracja nastaw [6]

Main function of safety devices is overcurrent protection. Safeguard actuation time for current value is defined by time-current characteristics.

$$t = \frac{k}{\left(\frac{I}{I_S}\right)^{a} - 1} \tag{1}$$

when:

$$k = 0{,}14 - 120{,}00$$

$$a = 0{,}02 - 2{,}00$$

$$IS = 1{,}3 - 15{,}00 IR = 1{,}2\ IS$$

This characteristic is similar with fuse characteristic. In case of fuse breaker only one point is tested. For digital field controller there are many parameters, influenting on characteristic of curve (fig. 2), and many characteristic points. This is reason why digital field controller tests takes many time, and expensive testers are needed.

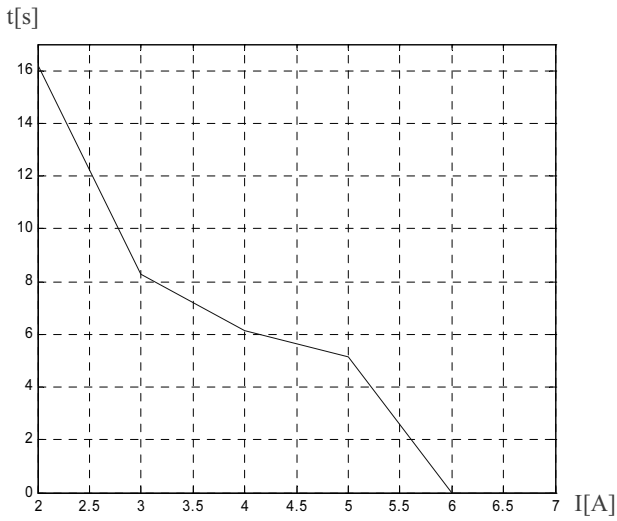


Fig. 2. Characteristic *t=f(I)*
Rys. 2. Przykładowa charakterystyka *t=f(I)*

In plant work many electrical protection devices. They work in different automatic configuration. An example of electrical system, working in SSBC is shown in fig. 3. Fig. 4 shows an algorithm [1].

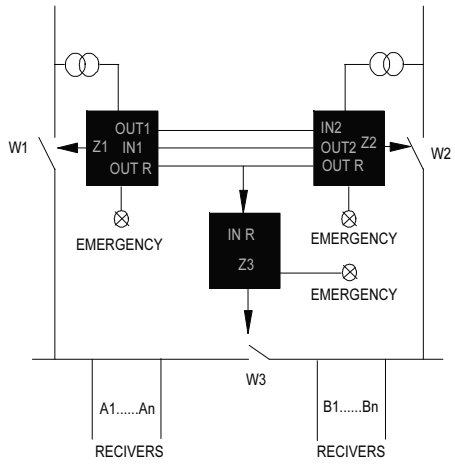


Fig. 3. Electrical system , working in SSBC [1]
Rys. 3. System elektroenergetyczny realizujący SZR [1]

There are two groups of recivers A and B, supplied by two breakers W1 and W2, from two others electrical systems. In case of failure in first system, W1 breaker is openen. Controll and emergency signals are generated. Activation and emergency signals are tested. W3 conector is close. All recivers are supply for second system, as shown in fig. 3. It is easy to imagin, that those tests takes many time. This tests are very important and acceptable quality is necessary [1].

My aim is to reduce test electrical protection devices time by optimization multiphase signals generator (calibrator) dynamic properties.

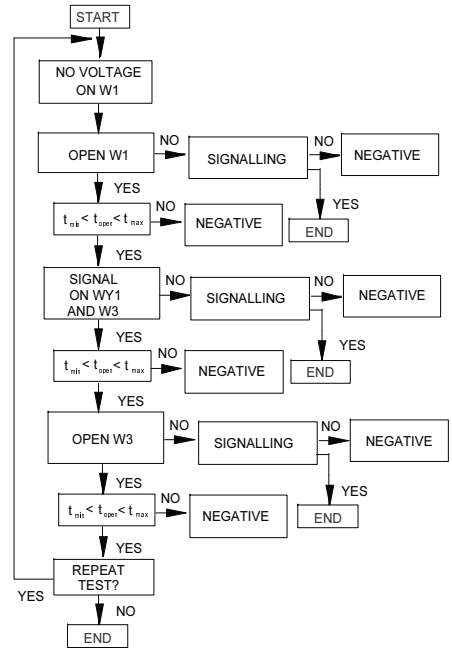


Fig. 4. SSBC test algorithm
Rys. 4. Algorytm testowania automatyki SZR

3. Testing systems

For testing electrical protection devices multiphase signals generator is necessary. It simulates activation signals, for example from current transformers. Device's answer is given to measurment card. For testing an object (plant) integrated testers are used (ISA, KOKOS, OMICRON). Closed tesing systems and integrated systems works in the same way. Fig. 5 shows test algorithm.

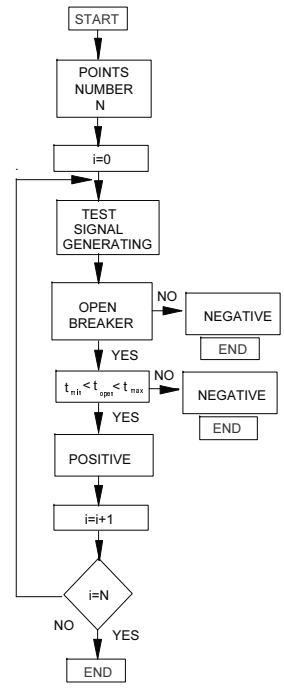


Fig. 5. Test algoirithm
Rys. 5. Algorytm testowania urządzeń EAZ

4. Obtained results

Model of electrical safety devices testing system was made in MATLAB, as shown in fig. 6.

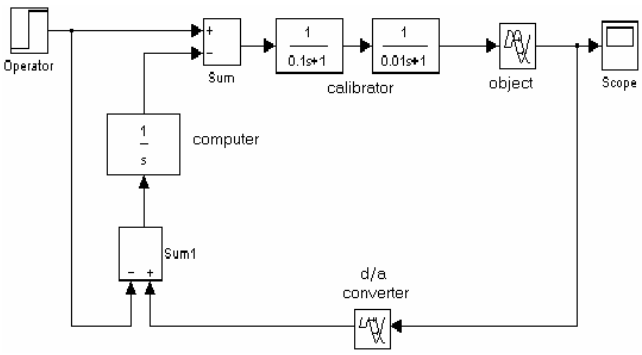
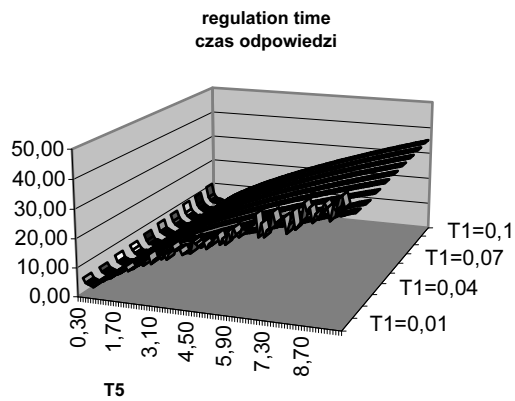


Fig. 6. Model of testing system
Rys. 6. Model systemu testującego urządzenia EAZ

The influence of calibrator parameters on regulation time and over-regulation has been tested simulation method. Fig. 7 shows the simulation results, for ten different calibrator time constans. T_1 is time constant of calibrator; T_5 is time constant of computer.

a)



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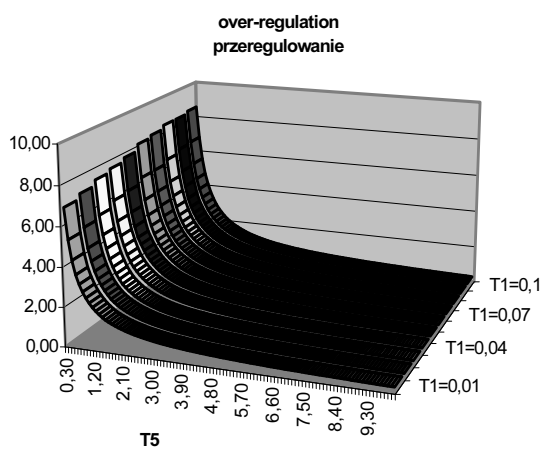

c)

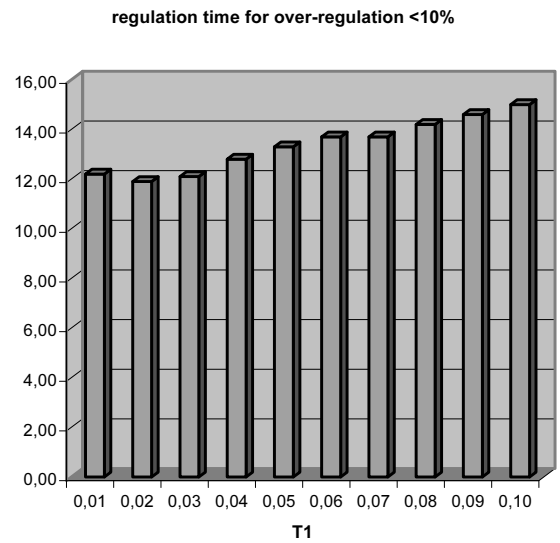

Fig. 7. Obtained simulation results
Rys. 7. Wyniki badań symulacyjnych

Obtained results are shown in tab. 1. They were compared with genetic algorithms results, obtained from paraller leaded tests [2].

Tab. 1. Results compare
Tab. 1. Porównanie wyników

parameters method	simulation method	genetic algorythms
T1 [s]	0,02	0,23
T2 [s]	0,01	0,13
T3 [s]	0,15	0,15
t reg [s]	11,9	14,7
overreg [%]	<10	9,84

Obtained results prove, that multiphase signals generator parameters have important impact on electrical safety devices testing. In the future obtained results will be verified in real tests.

5. References

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Artykul recenzowany